AN EXPERIMENTAL INVESTIGATION INTO THE ANTISEPTIC VALUE OF IODOFORM.

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IN the autumn of 1887 I commenced a series of experiments with the object of corroborating or otherwise those which had been recently published by Rovsing and Heyn[1]. The results arrived at by the experimenters tended to show, as is now well known, that iodoform, as an antiseptic dressing, was entirely useless; that it has no germicidal action, and, indeed, that it might, by its application to a wound, be the immediate means of conveying infection. The experiments given below will be seen to corroborate to some extent in their results those previously arrived at by Heyn and Rovsing, and which many observers since (Sattler, Tilanus, Baumgarten, De Ruyter, Lübbert, Jeffries and others) have likewise to some extent verified. More strictly, however, the result of my own experiments may be said to support those arrived at by Sattler and Tilanus, who found that in some cases iodoform had an inhibitory effect upon the growth of certain microbes.

These various experiments by myself and others have been carried on in the laboratory and in a manner which can hardly be considered as a fair parallel to the use of the drug in the wards. Notwithstanding the adverse assertions of experimentalists, surgeons still maintain the antiseptic value of iodoform, and in one form or another it is at present used in large quantities as a wound application. It was this double feeling which I had myself, of its apparent value in the wards and of its apparent uselessness in the laboratory that led me to try another series of experiments which might approach more in their likeness to the clinical use of the drug.

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[1] Fortschritte der Medicin, 1887, 5, 33.

These experiments, which will be subsequently given in detail, were made with pus taken from acute inflammatory processes; and to the pus so obtained different quantities of iodoform were added. Agar-agar plate cultivations were then made of the pus thus treated and the results compared with those made of pus to which no iodoform had been added. The great difference between the original experiments, as performed by Heyn and Rovsing, and these latter will be seen to lie in the fact that in the former pure cultivations of microbes were made use of, while in the latter microbes were such as they are to be found in pus. There really is a wide difference between the two. To express it numerically one might say that in using pure cultivations we were employing microbes by the million, whereas in using pus we have them simply by the hundred or the thousand. The addition of iodoform might, therefore, be incapable of producing any effect upon microbes existing in such large numbers, while it might possibly have some retarding or perhaps some marked deleterious effects upon microbes existing—as they do in pus or on a wound—in comparatively small numbers. It was this idea that led me to try the series of experiments which have ended in showing that iodoform may, under conditions, act as a germicide, although its action as such is very weak.

FIRST SERIES OF EXPERIMENTS.

These experiments were made with pure cultivations of anthrax spores, anthrax bacilli, micrococci prodigiosi and staphylococci pyogenes aurei.

A. With Anthrax Spores:

1. Silk threads with anthrax spores were mixed well with iodoform and pressed on to the surface of sloped Koch's beef-peptone jelly, itself previously slightly sprinkled with iodoform.

As a control experiment a similar thread, non-iodoformized, was placed upon the surface of another tube of jelly.

At the end of seven days there were no signs of growth in the iodoformized tube, but abundant in the control tube.

At the end of fourteen days marked development had taken place in the iodoformized tube.

2. A silk thread with anthrax spores was embedded in iodoformized beef-peptone jellv.

At the end of seven days marked development had taken place around the thread.

At the end of twenty-one days there was considerable liquefaction of the jelly.

B. With Anthrax Bacilli:

1. Anthrax bacilli were planted upon the oblique surface of the tube of iodoformized agar-agar jelly.

Anthrax bacilli also planted upon the surface of non-iodoformized jelly for control experiment.

On the second day the control showed signs of rapid growth.

On the third day one iodoformized tube showed marked signs of development.

2. A tube of iodoformized beef peptone jelly was "stabbed" with anthrax bacilli. A similar tube of pure jelly also "stabbed" for control experiment.

On the second day marked signs of liquefaction were seen in the iodoformized jelly.

At the end of 21 days both control and iodoformized jelly showed an equal amount of liquefaction.

C. With Micrococcus Prodigiosus:

1. Some of the pure cultivation of the microbe taken from the surface of agar-agar jelly was well mixed with iodoform so as to form a brick-dust colored paste.

A beef peptone jelly tube was "stabbed" (impfstich) with some of this mixture.

After one day liquefaction of the jelly was seen to have commenced, and the microbe continued to develop

2. Some of the same paste was spread upon a potato.

A feeble growth took place at the room temperature.

2. *a.* After the paste had been on the potato for 8 days, a beef-peptone jelly was "stabbed" with it.

At the end of one day growth was observed and rapid liquefaction ensued.

3. Some of the pure cultivation was spread upon the surface of a potato, previously dusted with iodoform. The potato was kept at the room temperature.

After a few days, growth began to show itself in several places on the surface of the iodoform, subsequently extending from each centre; growth proceeded, however, for only two or three days, darkening in color and then becoming stationary. Four weeks later some of the growth was inoculated into a beef-peptone jelly tube. Within two days rapid development took place.

The potato was again dusted on its surface thoroughly with iodoform, covering thereby completely the growth also. It was placed in the incubator and kept at a temperature of 37°C.

At the end of 7 days three beef-peptone jelly tubes were stabbed from the surface layer on the potato.

Rapid development of the microbe, with liquefaction of the jelly ensued.

4. Iodoform was mixed with potato so as to form a kind of paste having a distinct yellow tinge.

Some pure cultivation of the microbe was smeared upon the surface of the paste.

After 1 day signs of growth were seen.

After 2 days further growth ceased. The pigmentation deepened, subsequently assuming a dark brownish-red color.

4. *a.* After 8 days some of the dark reddish material from the surface of the potato was planted upon the oblique surface of agar-agar jelly.

Within 24 hours rapid development was seen.

5. The same experiment as 4, only instead of being left at the room temperature, the inoculated iodoform potato-paste was placed in the incubator and kept at a temperature of 37°C.

At the end of 24 hours no growth was observed. Experiment 4 was repeated in the following way for better comparison of the effect of difference of temperature upon rapidity of growth:

Three potato-pastes were made; two were iodoformized, the third was left for control.

Upon the surface of each an equal quantity of the microbe was smeared:

Placed in Incubator. (37°C.)	*Left in the Room.* (15.5°C.)	*Control left in the Room.* (15.5°C.)
On 2nd day. No growth and becoming quite dark.	No growth and very slightly darker.	Slight signs of growth.
End of 1st week. The growth has turned a faded purplish color. Around the margin is an almost colorless stratum. Taken out of incubator and left in the room.	Signs of growth. Color maintained.	Marked signs of growth.

End of 3d week. Growth appears to have progressed almost equally in all three, although slightly more extensive in control.

Koch's beef-peptone jelly tubes were "stabbed" from each.

On the following day equal and rapid liquefaction of the jelly, with growth was taking place along the "stab" in each tube.

6. A tube of Koch's beef-peptone jelly was iodoformized and "stabbed" with the microbe.

Within 24 hours rapid liquefaction was taking place.

7. Two tubes of the agar-agar jelly were iodoformized and the microbe planted upon their oblique surfaces. Two non-iodoformized tubes also inoculated and used as control. One control and one iodoformized tube placed in the incubator, the other two left in the room.

After 24 hours no development seen in either iodoformized tube, but extensive growth in both controls.

After 3 days rapid growth was taking place in the iodoformized tubes.

D. Experiments with Staphylococcus Pyogenes Aureus:

1. Two tubes of agar-agar jelly were iodoformized and two of the pure jelly were used as control. Upon the oblique surface of all four some pure cultivation of the microbe was planted and the tubes placed in the incubator.

Within 24 hours no growth had taken place in the iodoformized tubes but abundant development in the controls.

After the 3d day some growth was observed in the iodoformized tubes. A little of the growth was planted upon the oblique surface of two agar-agar jelly tubes and the latter then placed in the incubator.

Within 24 hours abundant growth had taken place in each tube.

2. A pure cultivation of the microbes on agar-agar was taken and mixed with iodoform so as to form a golden colored paste. Some of

the paste was planted upon the oblique surface of three agar-agar jelly tubes and the latter placed in the incubator.

After 24 hours a very slight development was seen in one tube.

After 48 hours extensive development in the other two.

After the 4 days the three tubes showed each abundant development.

3. A similar paste to that in experiment 2 was made. Two of Koch's beef-peptone jelly tubes were "stabbed" with some of the paste and exposed to the room temperature. One jelly tube was "stabbed" with a pure cultivation of the microbe and kept as control.

On the 2d day slight liquefaction was seen in the control; nothing in the other two tubes.

On the 3d day indication of liquefaction in both iodoform tubes, much more in one than the other.

On the 4th day liquefaction proceeding rapidly in both iodoform tubes, but development in the control has advanced beyond that of the other two tubes.

Conclusions to be Deduced from the Above Experiments.—The experiments with anthrax spores and anthrax bacilli showed that the effect of adding iodoform to the cultures was to retard growth but not to prevent it, as in all cases rapid and continuous development sooner or later took place.

In these experiments with anthrax bacilli my own results confirm those previously arrived at by Neisser and Buchner.

The experiments with micrococcus prodigiosus show also that the presence of iodoform in the cultures has a retarding effect, and further that this retardation is prolonged when the temperature is raised.

Some of these experiments would also seem to support Jeffries' theory that retardation may in many cases be due to the purely mechanical effect of the iodoform separating the microbe from its soil. Especially would this seem to be the case where iodoform has been previously dusted upon the surface of the medium which is to have implanted upon it the microbe.

In no case was growth entirely inhibited. The experiments with staphylococcus pyogenes aureus showed that the addition of iodoform, either to the microbes themselves or to the soil upon which they were to be implanted, had the effect of retarding growth, but in no case did the microbes appear to be deleteriously affected.

These experiments with staphylococcus pyogenes aureus do not agree in their results with those obtained by Neisser who states that in his experiments with this microbe iodoform in no way affected its growth.

SECOND SERIES OF EXPERIMENTS.

This series of experiments in which pus from acute abscesses (with one exception for special reasons) and from suppurating surfaces (non-tuberculous) was used in place of pure cultivations of microbes, was commenced in July, 1888, and continued up to the present date.

In all cases of experimentation pus was obtained in sterilized tubes and then when possible, the latter with the contained pus were at once conveyed to the incubator and maintained at the temperature of the body. Prior to placing in the incubator the tubes were covered with small India rubber caps to prevent any watery evaporation.

The iodoform used was the finely powdered form.

The first few experiments were done in the following way: By means of a platinum loop needle a small streak of pus was drawn upon the oblique surface of a tube of agar-agar jelly. This was then placed in the incubator and watched. Certain quantities of iodoform were added to measured quantities of pus and the pus thus iodoformized planted upon agar-agar jelly in the same way. By this means it was possible to compare the effect of iodoform upon the development of any existing microbes. In theory this mode of experimenting seemed, at first, likely to prove of value in testing the antiseptic worth of iodoform; practically, however, it turned out otherwise. Results were sometimes conflicting and the method was not sufficiently sensitive. For these reasons, therefore, I gave up any further experiments in this way and adopted the much more certain though much more tardy and difficult means of making in all cases plate cultivations.

Before, however, giving the result of these latter I will detail one experiment of the former method which gave a positive result and led me to believe that in principle I was possibly on the right basis for arriving at a just conclusion of the real antiseptic merits of iodoform.

The pus was obtained from a case of pyæmia.

July 9. Upon the sloped surface of two agar-agar jelly tubes some of the pus was planted and the tubes placed in the incubator. Five grains of iodoform were added to ʒi of pus and placed in the incubator.

July 10. Abundant development in both inoculated tubes, the surface of the jelly in each tube being completely covered by growth.

July 11. Two agar-agar jelly tubes were inoculated with the iodoformized pus (i. e., 2 days after the insertion of the iodoform).

July 12. Development along the streak of inoculation seen in both tubes. Two fresh agar-agar jelly tubes inoculated with the iodoform pus (i. e., 3 days after the insertion of the iodoform).

July 13. Development in both tubes slightly less than in the previous experiment. Two fresh agar-agar jelly tubes inoculated with iodoformized pus (i. e., 4 days after the insertion of the iodoform).

July 14. Development in both tubes considerably less than in previous experiment. The colonies could now be easily enumerated. Two fresh tubes inoculated (i. e., 5 days after insertion of iodoform).

July 15. Result: No development. Two fresh tubes inoculated (i. e., 6 days after insertion of iodoform).

July 16. Result: No development.

The one omission in this experiment was not making finally a control cultivation to see whether in the original pus microbes were still alive and in abundance on July 16, when the iodoformized pus showed that they were all dead. That, however, the original pus was still actively septic and contained living microbes, the following experiment carried on only two days later unmistakably proved.

In this second experiment, 2 grains instead of 5 grains of iodoform were inserted into one drachm of the pus.

At the end of 1 week, some of this iodoformized pus was planted upon the oblique surface of agar-agar jelly and placed in the incubator. Development subsequently hatched as luxuriantly as if no iodoform had been added.

Many of these experiments were done according to this method, but for reasons above given they were abandoned. Those now to be described were commenced in January, 1889. It was not, however, until March that any real progress was made, for while in the previous two months numerous experiments had been made, they had all been rendered useless by the constant contamination of the plate by bacterium termo. It was sometime before the actual cause of this contamination was detected; and revealed, notwithstanding the inconvenience it had caused, the interesting and instructive fact of the tenaciousness to life of the microbe of decomposition. It was always noticed that the development of the microbe took place on the under surface of the jelly, that is to say, between the jelly and the glass surface, thus suggesting that it was probably not associated with the jelly but with the plate. The plates had always been soaked for a short time in a 1 to 1,000 bichloride of mercury solution prior to being heated up to, and frequently above, a temperature of 150° C. It was not until the plates were left for a much longer period in the bichloride solution that a complete sterilization was effected. These microbes thus seemed to resist high temperature but could not withstand prolonged immersions in bichloride of mercury solutions.

The experiments will now be given in the order in which they were made.

Experiment A.—The pus was taken from a case of empyema. It presented a faint smell of the bacillus of green pus.

February 26. Agar-agar plate cultivations were made of the pus; one original and first and second attenuation. (The term "original," which will be frequently used, indicates the inoculation of a tube with a definite quantity of pus, as the case may be either iodoformized or not. A glass rod is taken with a piece of platinum wire welded into its extremity. The free end of the wire is loosely twisted or coiled so as to give it the appearance of a loose knot. This when dipped into the pus takes up a small drop. The advantage of using, for this purpose, a platinum needle is that it can be easily and rapidly sterilized in the open flame. Thus then what is understood by the original (O) is the tube of agar-agar jelly which contains a small drop of pus obtained by dipping this knotted needle first into the pus and then into the jelly where it is well shaken about to ensure the pus with its contained microbes being scattered or diffused throughout the culture medium).

In 100 minims of pus 5 grains of iodoform were added (known as I5.

To another 100 minims 10 grains of iodoform were added (known as I10).

February 27. The plate cultivations of the pus show:

O (Original) Numerous green colonies; smell like that of the bacillus of green pus,

1. Attenuation: Two whitish colonies.
2. Attenuation: No colonies.

Plate cultivations made of each of I5 and I10.

February 28. The plate cultivations of both I5 and I10, show a large number of colonies of green pus.

March 1. Plate cultivations made of I5 and I10 (i. e., three days after the insertion of iodoform).

March 3. Plate cultivation of I5 shows about 11 small colonies, apparently none green. Plate cultivation of I10 shows numerous minute colonies with no apparently green ones.

March 8. No development in either plate.

Experiment B.—This pus was obtained from a case of pelvic cellulitis.

March 29. An agar-agar plate cultivation was made of the pus. To a tube containing 50 minims of the pus, 5 grains of iodoform were added (I5).

March 30. The plate cultivation of the pus shows a number of colonies; several large white and numerous small yellowish ones. They are not too numerous to be counted. A plate cultivation made of I5.

March 31. The plate cultivation of I5 shows about 14 minute colonies.

April 1. Two plate cultivations made of I5 (i. e., two days after the insertion of the iodoform).

April 2. The plate cultivations show one or two colonies. Two fresh plate cultivations made (i. e., three days after the insertion of the iodoform).

April 5. Each plate cultivation shows only one colony. This experiment was carried still farther and the pus which so far had been rendered free from living microbes by the iodoform was inoculated from a pure cultivation of bacterium termo (I5 B.T.).

April 4. Two plate cultivations made of I5 B.T.

April 5. Each plate cultivation showed innumerable colonies of bacterium termo. Ten grains more of iodoform added to the tube (I15 B.T.).

April 8. Two plate cultivations made of I15 B.T. (i. e., three days after the insertion of the iodoform).

April 9. Both plates densely sprinkled with colonies of bacterium termo.

Experiment C.—The pus was taken from a large chronic abscess. Cover-glass preparations were made and stained by Gramm's method, but no microbes were found.

May 8. Two "original" plate cultivations were made.

May 9. Both plate cultivations showed no colonies. The pus being thus proved to be free from pus microbes was experimented upon in the following way:

May 10. Four drachms of pus were inoculated with staphylococcus pyogenes aureus. A visible quantity of the microbe was taken from the surface of a pure cultivation on agar-agar jelly by means of a loop of platinum wire.

May 13. The four drachms of pus inoculated with stapylococcus pyogenes aureus was divided into three tubes. One tube contained ʒij (A); a second tube ʒj (B); and a third tube ʒj (B). An agar-agar plate cultivation was made of both Bs.

May 14. The plate cultivations of both Bs show extensive development of staphylococcus pyogenes aureus. To one B is added 10 grains of iodoform (B10). To the other B is added 5 grains of iodoform (B5).

May 15. Plate cultivations made of B10 and B5.

May 16. Both plate cultivations of B10 and B5, show extensive development of staphylococcus pyogenes aureus.

May 17. Plate cultivations again made of B10 and B5.

May 18. The result of plate cultivations the same as on the 16th.

May 20. Plate cultivations again made of B10 and B5 (i. e., six days after the insertion of the iodoform).

May 21. The plate cultivations show innumerable colonies of staphylococcus pyogenes aureus.

May 18. Plate cultivations were made of A to see if the organisms were still alive.

May 19. The plate cultivations of A show the entire surface of the jelly to be completely covered with innumerable colonies of staphylococcus pyogenes aureus. To A is added 20 grains of iodoform (A20).

May 20. Plate cultivations made of A20.

May 21. Plate cultivations made of A20 show innumerable colonies of staphylococcus.

May 22. Plate cultivations made of A20 (i. e , three days after the insertion of the iodoform).

May 23. The plate cultivations show innumerable colonies of staphylococcus pyogenes aureus.

Experiment D.—The pus was obtained from an acute inguinal abscess following a sore upon the foot. Cover-glass preparations made and stained after Gramm's method showed the existence of micrococci almost as numerous as if they had been taken from a pure cultivation of the microbe.

May 29. Agar-agar plate cultivations were made up to the third attenuation.

May 30. All four plates, including therefore the third attenuation, show innumerable colonies of the staphylococcus pyogenes aureus.

June 1. To about one drachm of the pus 20 grains of iodoform were added (I20). To another drachm 30 grains were added (I30).

June 3. Two agar-agar plate cultivations made, each of I20 and I30.

June 4. Both plates of I20 and I30 show innumerable colonies.

June 7. Plate cultivations made of I20 and I30 (i. e., six days after the insertion of the iodoform).

June 8. Both plate cultivations show innumerable colonies of the staphylococcus.

Experiment E.—The pus was obtained from a cellulitis about the ankle joint of a child, following a punctured wound of the sole of the foot caused by broken glass.

June 15. Three tubes containing about one drachm of pus were thus made use of: One was kept as a control (C). To another was added 20 grains of iodoform (I20). To the third was added 30 grains of iodoform (I30). Agar-agar plate cultivations were also made of the pus non iodoformized—Two originals (O) with a first and second attenuation.

June 17. One plate cultivation of O shows numerous colonies, the other O only three colonies.

The first attenuation shows two colonies.

The second attenuation shows no colonies.

Two plate cultivations made of control (C), one plate cultivation of I20 and one of I30.

June 18. The results of the plate cultivation are:

Both Cs show innumerable colonies.

I20 shows no colonies.

I30 ditto.

Plate cultivations again made of C, I20 and I30.

June 19. The results of the plate cultivations are:

C shows innumerable colonies.

I20 shows one colony.

I30 shows no colonies.

To the control (C) 15 grains of iodoform added (CI15).

June 20. Three plate cultivations made of CI15. Both I20 and I30 inoculated with bacterium termo (I20 B.T. and I30 B.T.).

June 21. The result of the three plate cultivations of CI15 shows no development.

Two plate cultivations made of CI15.

One plate cultivation made of I20 B.T.

One plate cultivation made of I30 B T.

June 22. No development in plates of CI15; also no development in plates of I20 B.T. and I30 B.T.

June 24. Two plate cultivations made of I20 B.T. and one of I30 B.T.

June 25. All three plate cultivations show several colonies of bacterium termo.

Experiment F.—The pus was obtained from an abscess of the scalp of a child. Cover-glass preparations stained by Gramm's method several clumps of micrococci.

June 25. Agar-agar plate cultivations were made of the pus. One drachm of pus kept as control (C). To another drachm of pus is added 10 grains of iodoform (I10).

June 26. Results of plate cultivations of pus:

C shows complete clouding of the jelly with colonies.

First attenuation shows an almost countless number of colonies.

Second attenuation shows about 75 colonies. The colonies are almost entirely those of staphylococcus pyogenes aureus.

Two plate cultivations made each of I10 and C.

June 27. Results of plate cultivations:

Both Cs show dense clouding of the surface of the jelly.

Both I10s show innumerable colonies but they are quite distinct and separable from each other.

Two plate cultivations made of I10.

To I10 is added another 10 grains of iodoform, making 20 grains in all (I20).

June 28. Both plate cultivations of I10 show much the same condition as on the 27th. Two plate cultivations made of I20.

June 29. Both plate cultivations of I20 show great reduction in the number of colonies, which are easily enumerable.

The conclusions to be drawn from these experiments may be summarized as follows:

From Experiment A.—The addition of 5 and 10 grains of iodoform respectively, to two separate quantities of $1^1/_2$ drachm of pus caused the death of the bacillus of green pus and some other pus organisms present, in 9 days.

From Experiment B.—The addition of 5 grains of iodoform to a little less than a drachm of pus caused the death in 4 days of the comparatively few microbes of staphylococcus pyogenes aureus and albus present.

The further addition of 10 grains of iodoform after inoculation with bacterium termo, failed after 3 days, to have any effect upon the development of this saprophitic microbe.

From Experiment C.—The addition, respectively, of 5 and 10 grains of iodoform to two separate quantities of a drachm of pus inoculated with a comparatively large quantity of staphylococcus pyogenes aureus failed to have any effect after 5 days' action. Similarly the addition of 20 grains of iodoform failed after 3 days, to have any effect. In this experiment the quantity of the microbe inoculated appears to have converted the pus into what might be likened to a pus cultivation of the organism, so that the experiment might be classed with those where iodoform was tested with pus cultivation (vide first series of experiments).

From Experiment D.—The addition of 10 grains of iodoform to 1 drachm of pus showed after 3 days' action, considerable diminution in the quantity of the microbe present. The microbe was the staphylococcus pyogenes aureus, and although existing in large numbers it was not sufficient to withstand entirely the action of the iodoform.

From Experiment E.—The addition of 20 and 30 grains respectively to two separate quantities of a drachm of pus showed that after only 1 day's action of the iodoform, the microbes were killed. In this experiment the microbe was the staphylococcus pyogenes aureus. It existed in very small numbers, while the quantity of iodoform present was very large. The experiment also showed the almost complete powerlessness of iodoform on bacterium termo with which the iodoform tube had been inoculated.

From Experiment F.—The addition of 20 and 30 grains of iodoform respectively to two separate qantities of a drachm of pus failed to have any effect after 6 days' action of the drug. In the experiment, the microbe was the staphylococcus pyogenes aureus and existed in a very large quantity; indeed, approaching—as in experiment C—to what might be likened to a pus cultivation of the microbe.

General Conclusions to be drawn from the Second Series of Experiments.—These experiments would seem to prove that under certain conditions iodoform has a germicidal effect upon pyogenic microbes and no influence upon one putrefactive microbe—bacterium termo; that the only conditions which allow of this effect is the existence in large excess of iodoform or the presence in comparatively small numbers of the microbes.

Where the microbes are in abundance, some retarding influence appears to be exercised by iodoform upon their growth and even some diminution in the numbers which subsequently develop; but, if the number present be so large that the pus may approach to the condition resembling "pus cultivation" of the microbe, then the experiment resembles those of the first series and the result the same, *i. e.*, no germicidal effect is observed.

The general result then, of this second series of experiments is to show that iodoform has some distinctive power, and that its supposed or acknowledged value in the wards is borne out by experiments in the laboratory.

It may fairly be assumed that where iodoform is added to a wound, it will be largely in excess of any microbes present and therefore precisely in the position in which the experiments seem to indicate its aseptic power lies. Indeed, it is quite probable that such conditions as existed in the first series of experiments are rarely found to exist naturally; that is to say, no open wound is ever in the position of having anything comparable to a pure cultivation of microbes upon its surface. So that practically, iodoform, when used clinically, is always applied largely in excess of the existing microbes, and therefore capable of exercising advantageously its antiseptic properties.

Many theories have been propounded by those who believe in the antiseptic power of iodoform, as to how this influence is exercised. By some Sattler,[1] Tilanus[2] the microbes are supposed to be directly attacked by it. By others, (DeRuyter,[3] Behring[4]), it is their products, the ptomaines which are influenced. By others again, (Friedlauder,[5] Lübbert[6]) it is the wound surface itself, or the cells which are enabled to resist the deleterious effect of the microbes or the ptomaines. Still another theory has been advanced by Neudorfer[7] based on the supposition that microbes by their irritative action upon the nervous channels are the cause of inflammation, and that iodoform applied, acts as an antiseptic upon the sympathetic nerve fibres, rendering them insensible to any such irritative influence. Lastly, it has been supposed, Kœnig,[8] Jeffries,[9] that the effect of iodoform is to dry up the secretion on the surface of wounds, and so, as it were, starve any microbes which may perchance have found access to, or already exist on, the part.

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[1] Sattler, Ueber den Antiseptischen Werth des Iodoforms und Iodols. Fortsch. de Med., 1887, 5, 362.

[2] Tilanus, Ist Iodoform ein Antisepticum. Munch. Med. Wochensch, 1887, 34, 309.

[3] De Ruyter, Report Sixteenth Congress of German Surgery. Central f. Chirurg, 1887, Beil.

[4] Behring, Ueber Iodoform und Acetylene. Deutsch. Med. Wochensch, 1887, 20, 422.

[5] Friedlander, Das Iodoform als Antisepticum. Fortsch. d. Med. 1887, 5, 129.

[6] Lübbert, Ueber das Verhalter von Iodoform zum Staphylococcus Pyogenes Aureus. Fortsch. d. Med., 1887, 5, 330.

I have no intention of discussing these various theories, the object of this paper is rather to give the practical results of some of my own observations and experiments. It is possible that some of these theories are more or less correct, and that propounded by DeRuyter and Behring would especially seem to be so. By experiments they unmistakably showed that ptomaines without organisms were capable of causing suppurations and that iodoform was able so to act upon the ptomaines as to prevent suppuration. My own experiments prove, I think, that iodoform has a distinct effect upon the microbes themselves, but such effect is only produced when the drug is largely in excess of the organisms.

Surgeons who use iodoform with any real faith in its antiseptic properties do so in large qantities, as it is the only proper use of the drug which brings about the good results that occur.

As compared with many other much more powerful antiseptics, the special value of iodoform must rest upon its prolonged action. Solutions are absorbed, or carried away by the discharges, whereas iodoform remains as an almost permanent application. So that it is not infrequent to find, on the removal of a dressing, some weeks after its original application, the iodoform still on the surface of the wound, and as active—if the pungency of the odor may be accepted as a criterion of the continuance of its antiseptic power—as when first used.

In concluding this paper, I must acknowledge my great indebtedness to my friend Dr. Thos. H. Bryce, who has extended me much valuable assistance in carrying out many of the experiments. I am also indebted to various writers on the subject of iodoform in the pages of the ANNALS OF SURGERY for the useful information obtained from them as also for the many references therein given which I have been able to make use of and consult.

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